NIF
National Ignition Facility & Photon Science
Bringing Star Power to Earth

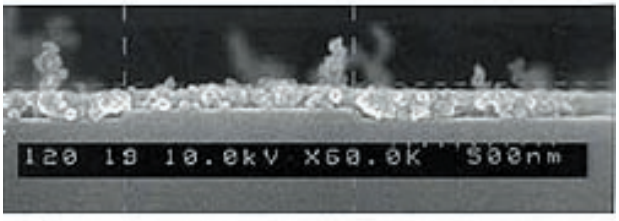
Advanced Optical Components & Technology

Wet-Etched Gratings, Reticles, and Kinoform Optics

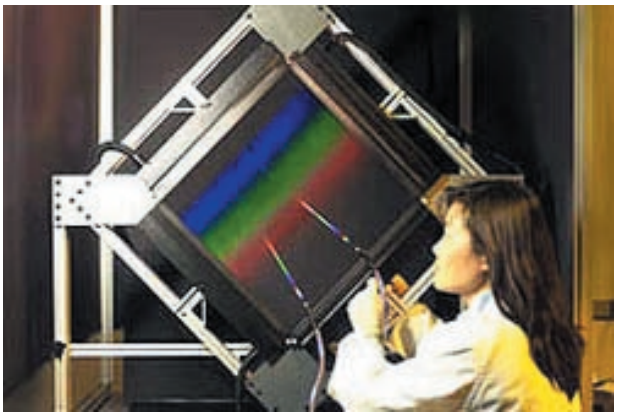
Using both proximity printing and holographic patterning techniques, AOCT designs and fabricates wet-etched, diffractive, binary or kinoform structures on optics having up to one-meter apertures. AOCT has developed a real-time etch-rate monitoring system for etch depth control to ten nanometers, and can execute maskworks of up to one-meter aperture, with submicron pixel placement.

AOCT fabricated the maskworks and the final, four-level wet-etched Fresnel lens in a fused-silica optic for a color-corrected, diffractive telescope application.

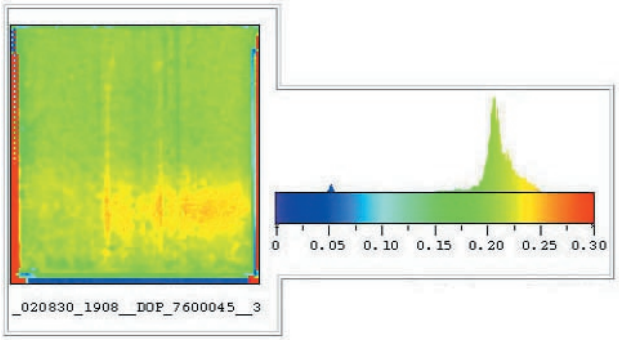
AOCT has designed gratings that transmit ultraviolet (351-nanometer) light with high efficiency while rejecting 532- and 1,053-nm light from the zero-order focus – also with high efficiency.



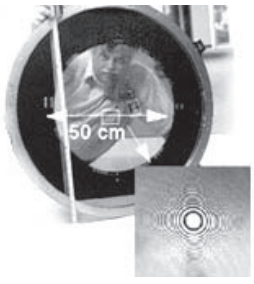
Scanning-electron microscope image of a beam-sampling grating (20-nm modulation) overcoated with a 75-nm-thick, sol-gel Si_{02} antireflective coating applied by spinning.



A holographically-written, focusing sampling grating on a 43-cm-square, fused-silica substrate. Grating grooves are approximately 15 nm deep on one to three micron centers.



Full-aperture, –1 order transmission diffraction efficiency of a 43-cm-square beam-sampling grating. Mean= 0.21% and RMS variation is 5 percent of mean, consistent with ± 1-nm-etch depth control.



A chrome-on-quartz mask for a 50-cm-diameter kinoform Fresnel lens. The smallest linewidths at the perimeter are 20 mm wide.

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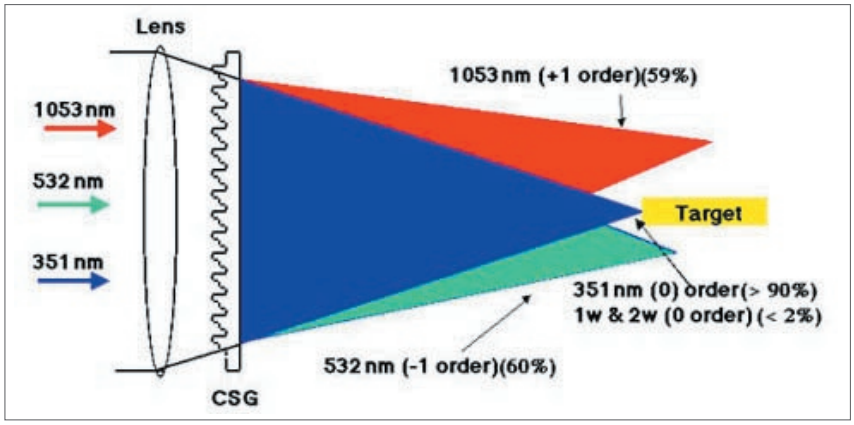
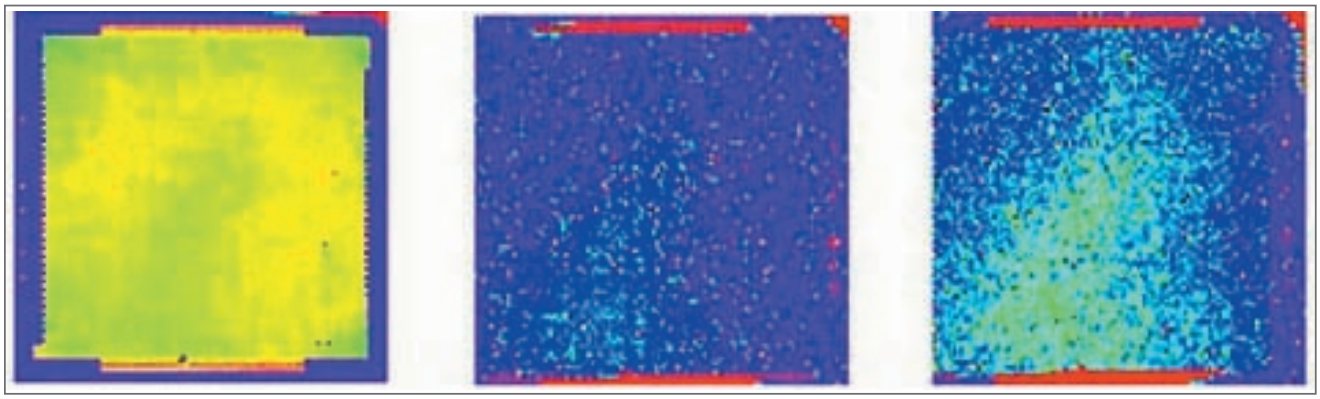
Advanced Optical Components & Technology – Gratings

A three-level stairstep (Dammann) grating for high-efficiency color separation of laser-light harmonics is depicted in the figure at right.



The three images below illustrate the measured, zero-order transmission efficiency of color-separation grating (CSG) at 351, 532, and 1,053 nm. The pattern was wet-etched using chrome artwork proximity printing on 40-cm^2 fused-silica panel.



The screenshot at right depicts AOCT's etch-monitoring system's graphical user interface; the program uses differential interferometry and back-side imaging to monitor and control wet-etch rates in real time, to accuracies of ±five nm.